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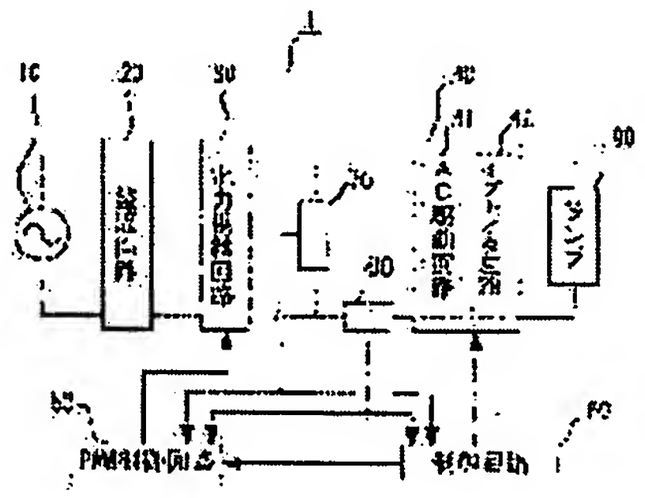
(54) **DISCHARGE LAMP DEVICE EQUIPPED WITH ARC STABILIZATION FUNCTION AND PROJECTOR USING THE DISCHARGE LAMP DEVICE**

(57)Abstract:
PROBLEM TO BE SOLVED: To provide a discharge lamp device capable of electrically controlling an arc jump or arc flicker of a discharge lamp.
SOLUTION: The discharge lamp device is characterized by being equipped with a discharge lamp 90, a power supply circuit 30, a driving circuit 40 driving in alternating current the discharge lamp 90 based on power supplied from the power supply circuit 30, detecting circuits (a lamp voltage detecting circuit 70 and a lamp current detecting circuit 80) to detect arc errors between electrodes of the discharge lamp 90, and a control circuit 60 to control the driving circuit 40 based on a detection result detected by the detecting circuits.



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CLAIMS

[Claim(s)]

[Claim 1]

Discharge lamp equipment equipped with a discharge lamp, DC power supply, the driving means that carries out the alternating current drive of said discharge lamp based on the power supplied from said DC power supply, a detection means to detect the inter-electrode abnormalities in an arc of said discharge lamp, and the control means which controls said driving means based on the detection result detected by said detection means.

[Claim 2]

Said detection means is discharge lamp equipment according to claim 1 which detects fluctuation of the operating voltage of said discharge lamp.

[Claim 3]

The 1st and 2nd resistance to which said detection means was electrically connected with the electrode of a discharge lamp at juxtaposition, Have the 1st comparison means and the connection node voltage formed between said 1st and 2nd resistance is supplied to the 1st input of said 1st comparison means. It is discharge lamp equipment according to claim 2 with which reference voltage is supplied to the 2nd input, and said 1st comparison means outputs the comparison result for said connection node voltage to said control means as compared with said reference voltage.

[Claim 4]

Said detection means is discharge lamp equipment according to claim 1 which detects fluctuation of the operating current of said discharge lamp.

[Claim 5]

The resistance for current detection to which said detection means was electrically connected with one [at least] electrode of said discharge lamp at the serial, Have the 2nd comparison means and the output voltage from said resistance for current detection is supplied to the 1st input of the 2nd comparison means. It is discharge lamp equipment according to claim 4 which said 2nd comparison means compares said output voltage and said 2nd reference voltage, and outputs the comparison result to said control means by supplying the 2nd

reference voltage to the 2nd input.

[Claim 6]

claim 2 by which said reference voltage or 2nd reference voltage is generated from the operating voltage or the operating current of said discharge lamp thru/or 5 -- discharge lamp equipment given in either.

[Claim 7]

claim 2 in which said 1st and 2nd comparison means contain the differential amplifier thru/or 5 -- discharge lamp equipment given in either.

[Claim 8]

Said detection means is discharge lamp equipment containing the photosensor which detects fluctuation of the quantity of light of said discharge lamp according to claim 1.

[Claim 9]

For this photodiode or a photo transistor, said photosensor is discharge lamp equipment according to claim 8 arranged near the discharge lamp including a photodiode or a photo transistor.

[Claim 10]

claim 1 in which said abnormalities in an arc include the arc jump jumped to the location where the arc separated from the desired location in inter-electrode [of a discharge lamp] thru/or 9 -- discharge lamp equipment given in either.

[Claim 11]

claim 1 in which said abnormalities in an arc contain the arc flicker which changes to the path from which the arc separated from the predetermined path in inter-electrode [of a discharge lamp] thru/or 10 -- discharge lamp equipment given in either.

[Claim 12]

claim 1 to which said control means enlarges alternating current drive frequency of said driving means according to the detection result of said detection means thru/or 11 -- discharge lamp equipment given in either.

[Claim 13]

claim 1 to which said control means carries out adjustable [of the duty ratio of the pulse drive current of said driving means] according to the detection result of said detection means thru/or 11 -- discharge lamp equipment given in either.

[Claim 14]

claim 1 to which said control means carries out adjustable [of the magnitude of the pulse drive current of said driving means] according to the detection result of said detection means thru/or 11 -- discharge lamp equipment given in either.

[Claim 15]

Said control means is discharge lamp equipment according to claim 14 which adds the pulse to which only a fixed period enlarges a pulse drive current synchronizing with falling of a

pulse drive current.

[Claim 16]

claim 2 by which said control circuit controls said driving means when said 1st comparison means or said 2nd comparison means detects the abnormalities in an arc including the OR circuit which inputs the comparison result of said 1st comparison means, and the comparison result of said 2nd comparison means thru/or 15 -- discharge lamp equipment given in either.

[Claim 17]

claim 2 by which said control circuit controls said driving means when said 1st comparison means and said 2nd comparison means detect the abnormalities in an arc including the AND circuit which inputs the comparison result of said 1st comparison means, and the comparison result of said 2nd comparison means thru/or 15 -- discharge lamp equipment given in either.

[Claim 18]

Said driving means is discharge lamp equipment including AC drive circuit containing the switching transistor which changes direct current voltage into alternating voltage, and the ignitor circuit which impresses the high voltage at a discharge lamp at the time of starting of a discharge lamp according to claim 1.

[Claim 19]

Said DC power supply are discharge lamp equipment including AC power supply and the rectifier circuit which rectifies the alternating voltage supplied from AC power supply according to claim 1.

[Claim 20]

Said discharge lamp is discharge lamp equipment according to claim 1 which contains in one the reflector made to reflect the light emitted from the discharge lamp.

[Claim 21]

It is the projector which has discharge lamp equipment, a modulation means to modulate the light from discharge lamp equipment optically, and a projection means to project the modulated light,

Said discharge lamp equipment is a projector equipped with a discharge lamp, DC power supply, the driving means that carries out the alternating current drive of said discharge lamp based on the power supplied from said DC power supply, a detection means to detect the inter-electrode abnormalities in an arc of said discharge lamp, and the control means which controls said driving means based on the detection result detected by said detection means.

[Claim 22]

Said modulation means is a projector containing a judgment means to classify the light from discharge lamp equipment in the light of the wavelength of R, G, and B at least, and the modulation element which modulates the light classified by this judgment means according to claim 21.

[Claim 23]

Said modulation element is a projector containing DMD according to claim 22.

[Claim 24]

Said judgment means is a projector according to claim 22 to which is equipped with the pivotable color wheel which has the color filter of R, G, and B, and outgoing radiation of the light which has the wavelength of R, G, and B one by one by carrying out incidence of the light to said color filter is carried out.

[Claim 25]

Said modulation means is a projector containing the liquid crystal light valve which modulates the light from discharge lamp equipment according to claim 21.

DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001]

[Field of the Invention]

This invention relates to the discharge lamp equipment especially used for the light source of the projector using a liquid crystal device or DMD (Digital Mirror Device) about the projector using discharge lamp equipment and this equipped with the arc stabilization function for stabilizing the arc of a discharge lamp.

[0002]

[Description of the Prior Art]

As the light source of the projector on which an image is optically projected and is displayed using a liquid crystal device or DMD, discharge lamps, such as a xenon lamp, a metal halide lamp, or an extra-high pressure mercury lamp, are used. These discharge lamps differ in spectral distribution, luminance distribution, luminous-intensity-distribution distribution, an electrical property, etc. by the gas metallurgy group, and the lamp suitable for the design specification of a projector is chosen.

[0003]

There are a direct-current mold lamp which impresses DC driver voltage to inter-electrode, and an alternating current mold lamp which impresses AC driver voltage to inter-electrode in a discharge lamp. One side of an electrode becomes cathode and, as for a direct-current mold lamp, another side serves as an anode plate. In order that the electron from cathode may always collide with an anode plate, the temperature of an anode plate tended to rise, therefore generally compared with cathode, the heat capacity of an anode plate was enlarged, and the temperature rise is controlled. On the other hand, since, as for an alternating current mold lamp, two electrodes turn into an anode plate and cathode by turns, the magnitude of an electrode has many same things fundamentally.

[0004]

As for a discharge lamp, it is desirable to use the short arc lamp which shortened inter-electrode arc distance. By carrying out like this, it is possible to generate the light of very high radiance, and since the light which emits light is also approximated to the point light source, when using optical members, such as a lens and a mirror, optical precision, such as optical refraction and reflection, can be raised.

[0005]

[Problem(s) to be Solved by the Invention]

In order to gather the condensing effectiveness of a lamp, in a projector, it is necessary to use the light spot of a short arc lamp for optical system, and to condense in the narrow range. However, in a short arc lamp, in order to make inter-electrode generate an arc jump, an arc flicker, etc., the technical problem that the homogeneity of luminous intensity distribution will collapse on a projection image even if it is difficult to condense in the narrow range and it condenses in the narrow range, or CHIRATSUKI will occur occurs.

[0006]

The configuration of the polar zone of an alternating current drive mold discharge lamp is typically shown in drawing 12 . A discharge lamp 400 includes cathode (or anode plate) 402 and an anode plate (or cathode) 403 in quartz glass 401. If pulse driver voltage is impressed between an electrode 402 and 403, the thermoelectron which jumped out of cathode 402 will collide to an anode plate 402, and discharge will be performed by inter-electrode.

[0007]

The thermoelectron emitted from cathode 402 is the shortest distance, and it is desirable to reach to an anode plate 403 in the same path. If distance is short, only in the part, resistance will also become small, if the path is the same, resistance or fluctuation of a current is also very small, and the quantity of light of a lamp is also stabilized. However, the thermoelectron emitted from the tip of cathode 402 in fact is easy to be emitted from the location where the tip sharpened. Electric field concentrate the part into which, as for this, the tip sharpened, and only the part is because the rise of temperature is larger than others. On the other hand, also in an anode plate 403, the part into which the tip sharpened makes temperature higher than other parts with the heat capacity. Consequently, the thermoelectron from cathode 402 may collide with an anode plate 403 in various paths. For example, as shown in drawing 12 , the thermoelectron from cathode 402 will follow the roots B or C which collide with the location in which the root A which collides with the tip location of the coil part wound around the anode plate 403, cathode 402, and the faced include angle were formed.

[0008]

Thus, generally it is called arc jump that the collision locations of the thermoelectron emitted from cathode differ, and the root of the thermoelectron from cathode to an anode plate changes, and it is called arc flicker that such a phenomenon is repeated a comparatively

quick period. The location with a projection as shown by the above-mentioned roots A, B, and C has high possibility that an arc jump and an arc flicker will occur, and, generally an arc flicker has occurrence frequency higher than an arc jump. On these specifications, the phenomenon containing an arc jump or an arc flicker is defined as an arc being unusual.

[0009]

This invention solves the technical problem of the conventional discharge lamp, and aims at offering the discharge lamp equipment which controlled generating of abnormalities in an arc, such as an arc jump and an arc flicker.

Furthermore, this invention aims at offering the discharge lamp equipment which can control electrically abnormalities in an arc, such as an arc jump of a discharge lamp, and an arc flicker.

Furthermore, the purpose of this invention is offering the projector which controlled CHIRATSUKI of a projection image and has improved the homogeneity of the luminous intensity distribution.

[0010]

[Means for Solving the Problem]

The discharge lamp equipment concerning this invention is equipped with a discharge lamp, DC power supply, the driving means that carries out the alternating current drive of said discharge lamp based on the power supplied from said DC power supply, a detection means to detect the inter-electrode abnormalities in an arc of said discharge lamp, and the control means which controls said driving means based on the detection result detected by said detection means.

[0011]

Since according to invention according to claim 1 a detection means detects the inter-electrode abnormalities in an arc of a discharge lamp and controlled the driving means by this, when the abnormalities in an arc (an arc flicker and arc jump) occur in a discharge lamp, drive control which controls it can be performed electrically.

[0012]

Preferably, a detection means detects fluctuation of the operating voltage of a discharge lamp. For example, a detection means has the 1st and 2nd resistance electrically connected with the electrode of a discharge lamp at juxtaposition, and the 1st comparison means. The electrical potential difference of the connection node formed between the 1st and 2nd resistance is supplied to the 1st input of the 1st comparison means, and reference voltage is supplied to the 2nd input. And the 1st comparison means compares the electrical potential difference and reference voltage of a connection node, and outputs the comparison result to a control means. Generating of the abnormalities in an arc fluctuates the lamp operating voltage. This is for resistance to change when the path of a thermoelectron changes in inter-electrode [of a discharge lamp]. For example, if the path becomes long, in connection

with it, resistance will become large. A detection means detects the abnormalities in an arc by detecting the lamp operating voltage which changed with change of resistance.

[0013]

A detection means detects fluctuation of the operating current of a discharge lamp preferably. For example, a detection means has the resistance for current detection electrically connected with one [at least] electrode of a discharge lamp at the serial, and the 2nd comparison means. The output voltage from the resistance for current detection is supplied to the 1st input of the 2nd comparison means, and the 2nd reference voltage is supplied to the 2nd input. The 2nd comparison means compares output voltage with the 2nd reference voltage, and outputs the comparison result to a control means. If the abnormalities in an arc occur, since inter-electrode resistance changes, the current which flows to a discharge lamp will also change. The abnormalities in an arc are detected by detecting change of the lamp operating current with a detection means.

[0014]

Preferably, reference voltage or the 2nd reference voltage is generated from the operating voltage or the operating current of a discharge lamp. A discharge lamp ages with the use years and operating frequency, and the lamp operating voltage and lamp operating current change from the time of an initial state. For this reason, as for reference voltage, it is desirable that it is a thing corresponding to such secular change etc. on the occasion of detection of the abnormalities in an arc. Moreover, the 1st and 2nd comparison means may contain the differential amplifier.

[0015]

A detection means may contain preferably the photosensor which detects fluctuation of luminescence of a discharge lamp. A photosensor can allot a photodiode and a ** photo transistor near the discharge lamp including a photodiode or a photo transistor. Generating of the abnormalities in an arc produces change of CHIRATSUKI etc. in luminescence with a discharge lamp, or the amount of luminescence. The abnormalities in an arc are detected by detecting the variation of light by the photosensor.

[0016]

The abnormalities in an arc contain the arc flicker which changes to the path from which the arc separated from the predetermined path in the arc jump jumped to the location where the arc separated from the desired location in inter-electrode [of a discharge lamp], and inter-electrode [of a discharge lamp].

[0017]

A control means makes high preferably alternating current drive frequency of a driving means according to the detection result of a detection means. It has become clear by making drive frequency high that generating of the inter-electrode abnormalities in an arc is controlled.

[0018]

A control means may be made to carry out adjustable [of the duty ratio of the pulse drive current of a driving means] according to the detection result of a detection means preferably. Since generating of the abnormalities in an arc is related to the temperature of an electrode, by changing a duty ratio, it adjusts the temperature of an electrode and controls generating of the abnormalities in an arc.

[0019]

A control means may be made to carry out adjustable [of the magnitude of the pulse drive current of said driving means] according to the detection result of a detection means preferably. For example, the magnitude of a pulse drive current can add the pulse for the arc stabilization with which only a fixed period enlarges a pulse drive current synchronizing with falling of a pulse drive current. A pulse can be added at the time of falling of a lamp current, and generating of abnormalities in an arc, such as an arc jump and an arc flicker, can be controlled by heating an electrode in an instant by forming the discharge location stabilized on the electrode.

[0020]

When the 1st comparison means or the 2nd comparison means detects the abnormalities in an arc, you may make it a control circuit control a driving means including the OR circuit which inputs the comparison result of the 1st comparison means, and the comparison result of the 2nd comparison means preferably. Or when the 1st comparison means and the 2nd comparison means detect the abnormalities in an arc, you may make it a control circuit control a driving means including the AND circuit which inputs the comparison result of the 1st comparison means, and the comparison result of the 2nd comparison means.

[0021]

A driving means includes preferably AC drive circuit containing the switching transistor which changes direct current voltage into alternating voltage, and the ignitor circuit which impresses the high voltage at a discharge lamp at the time of starting of a discharge lamp. DC power supply may include AC power supply and the rectifier circuit which rectifies the alternating voltage supplied from AC power supply. Moreover, a discharge lamp may contain in one the reflector made to reflect the light emitted from the discharge lamp.

[0022]

The projector concerning this invention has discharge lamp equipment, a modulation means to modulate the light from discharge lamp equipment optically, and a projection means to project the modulated light. And discharge lamp equipment is equipped with a discharge lamp, DC power supply, the driving means that carries out the alternating current drive of said discharge lamp based on the power supplied from said DC power supply, a detection means to detect the inter-electrode abnormalities in an arc of said discharge lamp, and the control means which controls said driving means based on the detection result detected by

said detection means.

[0023]

By having such discharge lamp equipment, CHIRATSUKI of the image projected from a projector can be controlled, and the homogeneity of the luminous intensity distribution of an image can be raised more.

[0024]

A modulation means contains preferably a judgment means to classify the light from discharge lamp equipment in the light of the wavelength of R, G, and B at least, and the modulation element which modulates the light classified by this judgment means. A modulation element contains DMD.

[0025]

Preferably, a judgment means is equipped with a pivotable color wheel with the color filter of R, G, and B, and carries out outgoing radiation of the light which has the wavelength of R, G, and B one by one by carrying out incidence of the light to a color filter. A modulation means may contain the liquid crystal light valve which modulates the light from discharge lamp equipment.

[0026]

[Embodiment of the Invention]

Hereafter, the gestalt of operation of this invention is explained to a detail with reference to a drawing.

Drawing 1 is the block diagram showing the configuration of the discharge lamp equipment concerning the gestalt of operation of the 1st of this invention. Discharge lamp equipment 1 includes AC power supply 10, the rectifier circuit 20 which rectifies the alternating voltage of AC power supply 10 to direct current voltage, the power supply circuit 30 which supplies stable power to a discharge lamp 90, the drive circuit 40 which drives a discharge lamp 90, the PWM control circuit 50 which controls the electric power supply of the power supply circuit 30, and the control circuit 60 which controls each part of drive circuit 40 grade. Discharge lamp equipment 1 includes the lamp voltage detector 70 which intervened further between current supply Rhine between the power supply circuit 30 and the drive circuit 40, and the lamp current detector 80 connected to one current supply Rhine. The lamp voltage detector 70 detects the operating voltage of a discharge lamp 90, and supplies the detected output to the PWM control circuit 50 and a control circuit 60, respectively. The lamp current detector 80 detects the operating current of a discharge lamp 90, and supplies the detected output to the PWM control circuit 50 and a control circuit 60, respectively.

[0027]

The drive circuit 40 has AC drive circuit 41 for carrying out the alternating current drive (AC drive) of the discharge lamp 90, and the ignitor circuit 42 which impresses the high voltage to a lamp at the time of starting of a discharge lamp 90. Discharge lamps 90 are a xenon

lamp, a metal halide lamp, an extra-high pressure mercury lamp, etc. Such discharge lamp equipment 1 is used for the light source of the projector which used a liquid crystal device and DMD.

[0028]

Drawing 2 is drawing showing the circuit of the discharge lamp equipment shown in drawing 1 .

The power supply circuit 30 contains MOS transistor 31, a pulse transformer 32, diode 33, an inductor (coil) 34, and a capacitor 35. The gate of MOS transistor 31 is connected to the secondary coil of a pulse transformer 32, and the upstream coil is connected to the PWM output signal 51 of the PWM control circuit 50. The pulse signal outputted from the PWM output signal 51 is answered, turning on and off of MOS transistor 31 is controlled, and pressure lowering of direct current voltage is performed. An inductor 34 and a capacitor 35 supply the direct current voltage which removed the component rippled from the transformed direct current voltage, and was graduated.

[0029]

The lamp voltage detector 70 is connected between current supply Rhine of the power supply circuit 30. The lamp voltage detector 70 contains the resistance R2 and R3 connected to the serial between Rhine, and the capacitor connected to juxtaposition at resistance R3. The connection node with resistance R2 and R3 is supplied to the PWM control circuit 50 and a control circuit 60.

[0030]

The lamp current detector 80 includes the resistance R1 for lamp current detection by which series connection was carried out to one current supply Rhine from the power supply circuit 30. The output of resistance R1 is supplied to the PWM control circuit 50 and a control circuit 60.

[0031]

The PWM control circuit 50 starts actuation by closing a switch SW1, and a switch SW1 is controlled by the control signal 61 outputted from a control circuit 60. The PWM control circuit 60 inputs the output of the lamp voltage detector 70, and the output of the lamp current detector 80, calculates lamp power from these outputs, and it controls the power supply circuit 30 so that power required for actuation of a discharge lamp 90 is supplied stably.

[0032]

It connects with the power supply circuit 30 through current supply Rhine, and AC drive circuit 41 has the CMOS transistors Q1 and Q2 for changing direct current voltage into alternating voltage, and Q3 and Q4. The CMOS transistors Q1 and Q2 and the CMOS transistors Q3 and Q4 constitute the CMOS inverter of a pair, and those gate electrodes are driven complementary through the driving signal 62 from a control circuit 60. Therefore,

when transistors Q1 and Q4 turn on, transistors Q2 and Q3 are off, and when transistors Q2 and Q3 turn on on the contrary, transistors Q1 and Q4 are off. In this way, the direct current voltage from the power supply circuit 30 is changed into alternating voltage by each inverter, and is impressed to a discharge lamp 90 by it. The conversion frequency of a direct-current-alternating current can be chosen as arbitration by carrying out adjustable [of the pulse frequency of the driving signal 62 from a control circuit 60]. A control circuit 60 can also carry out adjustable [of the duty ratio of the pulse driving signal of a driving signal 62] so that it may furthermore mention later.

[0033]

The output of each inverter is connected to a discharge lamp 90 through current supply Rhine of the ignitor circuit 42. The ignitor circuit 42 impresses the high voltage to a discharge lamp 90 at the time of starting of a discharge lamp 90, and causes arc discharge in a discharge lamp 90. The power supply circuit 30 controlled by the PWM control circuit 50 outputs about 250 thru/or the electrical potential difference of 370 volts to current supply Rhine, and this electrical potential difference is supplied to the ignitor circuit 42 through AC drive circuit 41. A current is accumulated in a capacitor 122 through diode 121 from the high potential side output of AC drive circuit 41, if this electrical potential difference exceeds constant value, a trigger device 123 will flow, a current is passed by the upstream coil of a transformer 124, and the current generated by the secondary coil by this is charged by the capacitor 126 through diode 125. If the electrical potential difference of a capacitor 126 exceeds the threshold of a varistor 127, a current will flow in the upstream coil of a transformer 128, and the very high electrical potential difference of about ten kilovolts will be generated by the secondary coil by this. And dielectric breakdown arises between the terminals of a discharge lamp 90, and arc discharge is started.

[0034]

A control circuit 60 outputs the control signal 61 which controls ON of a switch SW1, and OFF, and the driving signal 62 which controls the drive of AC drive circuit 41. Furthermore, a control circuit 60 includes comparator circuits 63 and 64 and the drive control circuit 65. The output voltage from the lamp voltage detector 70 is connected to one input of a comparator circuit 63, and reference voltage is connected to the input of another side. The output from the lamp current detector 80 is connected to one input of a comparator circuit 64, and reference voltage is connected to the input of another side. The output of comparator circuits 63 and 64 is inputted into the drive control circuit 65.

[0035]

A comparator circuit 63 detects abnormalities in an arc caused [in / as compared with reference voltage / for the output voltage from the lamp voltage detector 70 / inter-electrode / of a discharge lamp 90], such as an arc jump and an arc flicker. If an arc jump and an arc flicker occur, since an arc will discharge in the path from which it separated from the path of

a stationary, resistance changes with them. When it changes by choosing the reference voltage of a comparator circuit 63 as a predetermined value a lot than a value with fixed lamp operating voltage, it judges that it is [an arc] unusual.

[0036]

As compared with reference voltage, a comparator circuit 64 judges that the output voltage from the lamp current detector 80 is [an arc] unusual, when change of the lamp operating current is larger than a fixed value. The detailed configuration of a comparator circuit 63 is shown in drawing 3 . The input Vin of comparator 63a is connected to the output of the lamp voltage detector 70 for a comparator circuit 63 including comparator 63a. It connects with the RC circuit containing resistance R11 and a capacitor C1, and Input Vin is supplied to a noninverting input by making the output of this RC circuit into reference voltage. Moreover, the signal of Input Vin is connected to an inversed input terminal through resistance R12, and comparator 63a outputs the comparison result for this as Vout as compared with reference voltage. It has a configuration with the same said of a comparator circuit 64.

[0037]

The drive control circuit 65 makes high the frequency of the pulse driving signal of a driving signal 62, when the signal which shows the abnormalities in an arc from either a comparator circuit 63 or the comparator circuit 64 is inputted including the OR circuit which inputs the output of comparator circuits 63 and 64. The drive control circuit 65 drives AC drive circuit 41 on a frequency (H), when the abnormalities in an arc are not detected, when the abnormalities in an arc are detected, carries out adjustable [of the drive frequency] to the frequency (H1>H) set up beforehand, and drives AC drive circuit 41. Generating of the abnormalities in an arc can be controlled by making a frequency high.

[0038]

Next, actuation of the discharge lamp equipment concerning the gestalt of this operation is explained. Before the high voltage is impressed to a discharge lamp 90, a switch SW1 is in the condition of having opened. If the alternating voltage from AC power supply 10 is changed into direct current voltage by rectification / smoothing circuit 20 and a switch SW1 is turned on by the control signal 61 from a control circuit 60, the PWM output signal 51 will be outputted to a pulse transformer 32 from the PWM control circuit 50, turning on and off of MOS transistor 31 will be controlled by this, and the direct current voltage of about 250 - 370 volts will be supplied from the power supply circuit 30.

[0039]

AC drive circuit 41 is made the ON state by the control circuit 60 in transistors Q2 and Q3, 10K the high voltage of -20 kilovolts is impressed to inter-electrode [of a discharge lamp 90] by actuation of the ignitor circuit 42, and a current starts flowing by arc discharge.

[0040]

The PWM control circuit 50 is changed to power (watt) control, when current control to which

a lamp can operate safely is performed and lamp operating voltage rises with a temperature rise after that (for example, 65 volts), since the lamp operating voltage at the time of the early stages of discharge is low. On the other hand, a control circuit 60 makes the inverter drive of AC drive circuit 41 start with a driving signal 61, and transforms direct current voltage to alternating voltage. A lamp current as shown in drawing 7 (a) is impressed to inter-electrode [of a discharge lamp 90] by this. Moreover, since the ignitor circuit 42 makes the threshold electrical potential difference of the trigger device 123 about 200 volts, it does not operate by the alternating current from AC drive circuit 41.

[0041]

If abnormalities in an arc, such as an arc jump and an arc flicker, occur in a discharge lamp 90, lamp operating voltage or the lamp operating current will be changed. This situation is shown in drawing 4 . An arc flicker has the comparatively high frequency of change of lamp voltage and a lamp current according to it in order to make an arc path change or change a comparatively early period. On the other hand, an arc jump becomes comparatively low [the frequency of change of lamp voltage and a lamp current] in order to go back and forth the path from which an arc differs a comparatively late period.

[0042]

If the lamp voltage detector 70 has the relation connected to the electrode of a discharge lamp 90, and juxtaposition and lamp operating voltage is changed, the detection electrical potential difference from the connection node of resistance R2 and R3 will be changed. The relation of the input voltage Vin and output voltage Vout of a comparator circuit 63 is shown in drawing 5 . An input of the output voltage accompanied by an arc jump as shown in the input Vin of a comparator circuit 63 at drawing 5 inputs into comparator 63a the electrical potential difference from which the pulsating (fluctuation) component was removed by the RC circuit as reference voltage. On the other hand, since the signal which has a pulsating component is inputted into the inversed input terminal, a pulse signal is outputted by the comparison as output voltage Vout. It becomes possible from the output of the lamp voltage detector 70 to detect the electrical potential difference of the abnormalities in an arc exactly by generating reference voltage in consideration of change (for example, for operating voltage to change with wear of an electrode etc.) of the operating voltage by secular change of a lamp etc. In this way, the signal which shows the abnormalities in an arc detected by the comparator circuit 63 is supplied to the drive control circuit 65.

[0043]

If the lamp operating current is changed including the resistance R1 for current detection by which the lamp current detector 80 was connected with one electrode of a discharge lamp 90 at the serial, the output voltage of resistance R2 will be changed. This output voltage is supplied to comparator 64a as input voltage Vin of a comparator circuit 64, and the same actuation as the comparator circuit 63 mentioned above is performed. In this way, the signal

which shows the abnormalities in an arc detected by the comparator circuit 64 is outputted to the drive control circuit 65.

[0044]

In addition, comparator circuits 63 and 64 are not necessarily restricted to a comparator. For example, it is not necessary using the differential amplifier as shown in drawing 6 to say that it is possible to detect the abnormalities in an arc. In this case, the output voltage amplified from the detection result can be obtained.

[0045]

The drive control circuit 65 will carry out adjustable [of the pulse drive frequency of a driving signal 61], if the notice of the abnormalities in an arc is received from either of the comparator circuits 63 or 64. It has become clear that generating of the abnormalities in an arc is controlled by making drive frequency of a discharge lamp 90 high. For this reason, it is desirable to make high pulse drive frequency of a driving signal 61.

[0046]

In addition, although the drive control circuit 65 has the OR circuit which inputs the output of comparator circuits 63 and 64, it may be replaced with this and an AND circuit may be used for it. In this case, when fluctuation of the both sides of lamp operating voltage and the lamp operating current exceeds constant value and it judges that it is [an arc] unusual, the drive control circuit 65 carries out adjustable [of the drive frequency].

[0047]

The drive control crossroads 65 are good also considering the duty ratio of a pulse signal as adjustable besides carrying out adjustable [of the frequency of the driving pulse signal of a lamp]. The pulse shape of a driving signal 62 is shown in drawing 7 . A duty ratio D1 shows 50% (D1=T1/(T1+T2), T1=T2) of pulse driving signal, and, as for this drawing (a), this drawing (b) shows a pulse driving signal (T1> T2) with a larger duty ratio D2 than D1.

[0048]

When the abnormalities in an arc are detected based on the detection result of the lamp voltage detector 70 or/, and the lamp current detector 80, the drive control circuit 65 changes the duty ratio of a pulse driving signal into D2 from D1. The electrode which receives impression of the lamp current of a period T1 by changing a duty ratio into D2 goes up temperature rather than the electrode which receives impression of the lamp current of a period T2. For example, when the thermoelectron emitted from one electrode is unstable, it is possible to impress the lamp current of a period T1 to concerned one electrode, to stabilize the path of a thermoelectron by making temperature of concerned one electrode high, and to control generating of the abnormalities in an arc. The rate of a duty ratio can be suitably chosen according to the temperature situation of the thermal design of an electrode, or an electrode.

[0049]

Furthermore, the drive control circuit 65 may add pulse current which is superimposed on the pulse drive current other than the above drive control. Drawing 8 is drawing showing the wave of the lamp current which added the pulse 66 for arc stabilization to the pulse drive current. The pulse 66 for arc stabilization synchronizes with falling of a lamp current, and only period T3 smaller than the period (T1 or T2) of a lamp current enlarges magnitude (absolute value) of a lamp current.

[0050]

Temperature falls sometimes momentarily [the polarity of a lamp current], and, as for the electrode of a discharge lamp 90, generating of the abnormalities in an arc may be caused by it. For this reason, the pulse for arc stabilization is added synchronizing with falling of a lamp current, by setting up more highly the temperature of an electrode in case a lamp current changes a little rather than usual, the fall of the temperature of the electrode at the time of the polarity reversals of a lamp current is controlled, arc discharge is stabilized and generating of the abnormalities in an arc is controlled.

[0051]

In this example, although the pulse 66 for arc stabilization was added synchronizing with falling of a lamp current, in addition to this, it may start and, also sometimes, a pulse may be added. What is necessary is just to choose suitably period T3 and magnitude of the pulse 66 for arc stabilization according to the thermal design of an electrode, and the heat of an electrode.

[0052]

Drawing 9 is the block diagram of the discharge lamp equipment concerning the gestalt of operation of the 2nd of this invention. As shown in this drawing, in this example, it has the photodetection section 200 which detects the quantity of light of a discharge lamp 90. The photodetection section 200 checks fluctuation of the light from a discharge lamp 90, and supplies this result to a control circuit 60. If the abnormalities in an arc occur, since the lamp voltage or/, and a lamp current will be changed, CHIRATSUKI etc. arises in the light emitted from a discharge lamp 90 as a result. The photodetection section 200 gives the electrical signal according to change of the quantity of light of a discharge lamp 90 to a control circuit 60 including optoelectric transducers, such as a photodiode and a photo transistor, preferably.

[0053]

A control circuit 60 judges the abnormalities in an arc from the detection result of the photodetection section 200, and carry out adjustable [of the drive frequency] by the drive control circuit 65, a duty ratio is changed, or it adds the pulse for arc stabilization. In addition, you may make it a control circuit 60 equipped with the 3rd comparator circuit for measuring the output from the photodetection section 200 with a reference potential. When the output of the 3rd comparator circuit is made to input into the OR circuit of the drive control circuit 65 with the output of comparator circuits 63 and 64 and the abnormalities in

an arc are detected in either the lamp voltage detector 70, the lamp current detector 90 or the photodetection section 200, it judges with an arc being unusual and you may make it the drive control circuit 65 control actuation of AC drive circuit 41. Or only when an AND circuit is used instead of an OR circuit and the abnormalities in an arc are detected in all detecting elements, it judges with an arc being unusual and you may make it control actuation of AC drive circuit 41. It is also possible to apply the circuit shown in drawing 3 and drawing 6 to the 3rd comparator circuit.

[0054]

Drawing 10 is drawing showing the example of installation of the photodetection section 200 shown in drawing 9 . A discharge lamp 90 is attached in the optical axis of the reflector 91 which has an ellipsoid-of-revolution mirror or a paraboloid-of-revolution mirror, and it is arranged so that the core of the electrode of a pair may come to the focus of a reflector preferably. The closure of the open end of a reflector 91 is carried out with glass 92, and optical waveguide 93 is allotted to the location where glass 92 counters. Optical waveguide 93 is for example, a light tunnel or a light integrator. Furthermore a photodiode 94 is arranged in glass 92 and the location which counters, and a part of light reflected by the reflector 91 irradiates a photodiode 94. In this way, a discharge lamp's 90 generating of the abnormalities in an arc gives the electrical signal 95 which shows the abnormality from a photodiode 94 to a control circuit 60.

[0055]

Although the photodiode was used as the photodetection section in the mode of the 2nd operation, not only this but the thing for which sensing elements, such as other photo transistors, are used is possible. Moreover, an installation location also forms a slot or a crevice in a reflector, and you may make it attach a photodiode there in one in addition to glass and the location which counters.

[0056]

The discharge lamp equipment explained above can be used as the light source for projectors. The example which applied discharge lamp equipment to the projector of a DLP (Digital Light Processing) method is shown in drawing 11 .

[0057]

The light tunnel 302 which transmits the light by which the projector 300 was emitted from discharge lamp equipment 301 and discharge lamp equipment 301, The disc-like color wheel 303 by which is made to arrange the color filter of R, G, and B (or W), and a rotation drive is carried out, The incident light study system 304 which projects the light classified one by one by the color wheel 303 at the light of the wavelength of R, G, and B to up to DMD305, It has the incident light study system 306 which projects the light optically modulated by DMD305 and DMD305 which have the image field which consists of two or more micro mirror components made to arrange two-dimensional on a semi-conductor substrate to up to a

screen. By using the discharge lamp equipment 301 concerning the gestalt of this operation, CHIRATSUKI of a projection image can be controlled and the homogeneity of luminous intensity distribution can be collateralized.

[0058]

As mentioned above, although the gestalt of desirable operation of this invention was explained in full detail, various deformation and modification are possible for this invention within the limits of the summary of this invention which is not limited to the starting specific operation gestalt and was indicated by the claim.

[0059]

With the gestalt of this operation, although AC power supply is changed into DC power supply, not only this but DC power supply may be used as it is. The lamp voltage detector 70 and the lamp current detector 80 may be connected to locations not only not necessarily connecting between the power supply circuit 30 and the drive circuit 40 but other than this. Although the drive circuit 40 shall include the ignitor circuit 42, it does not necessarily need to include the ignitor circuit 42. An inductor is made to be placed furthermore between inductor current paths if needed in the ignitor circuit 42, and it may be made to make steep the standup and falling of a driving pulse signal.

[0060]

[Effect of the Invention]

Since according to the discharge lamp equipment concerning this invention the abnormalities in an arc caused inter-electrode [of a discharge lamp] are detected and the drive of a discharge lamp was controlled based on this detection result, it becomes possible to be able to control an arc jump and generating of an arc flicker electronically, to control CHIRATSUKI of a discharge lamp, and to raise the homogeneity of luminous intensity distribution. If such discharge lamp equipment is used for the light source of a projector, it is possible to control CHIRATSUKI of the image on which it is projected and to offer a high-definition image.

[Brief Description of the Drawings]

[Drawing 1] It is the block diagram showing the configuration of the discharge lamp equipment concerning the gestalt of operation of the 1st of this invention.

[Drawing 2] It is drawing showing the circuitry of the discharge lamp equipment shown in drawing 1 .

[Drawing 3] It is the circuit diagram showing the detail of comparator circuits 63 and 64.

[Drawing 4] It is drawing showing the signal wave form of an arc jump and an arc flicker.

[Drawing 5] It is drawing showing the input of a comparator circuit, and an output voltage wave.

[Drawing 6] It is the circuit diagram which applied **** amplifier to comparator circuits 63 and 64.

[Drawing 7] The wave of the lamp current impressed to a discharge lamp is shown, this

drawing (a) shows the case where a duty ratio is equal, and this drawing (b) shows the case where adjustable [of the duty ratio] is carried out.

[Drawing 8] It is drawing showing the wave of the lamp current impressed to a discharge lamp.

[Drawing 9] It is the block diagram showing the configuration of the discharge lamp equipment concerning the gestalt of operation of the 2nd of this invention.

[Drawing 10] It is drawing showing the condition of having attached in the discharge lamp the photodetection section shown in drawing 9 .

[Drawing 11] It is the block diagram showing the example which applied the discharge lamp equipment concerning this invention to the projector.

[Drawing 12] It is drawing explaining the condition of the inter-electrode abnormalities in an arc of a discharge lamp.

[Description of Notations]

30: Power supply circuit 40: Drive circuit,

41: AC drive circuit 42: Ignitor circuit,

50: PWM control circuit 60: Control circuit,

63 64: Comparator circuit 65: Drive control circuit,

70: A lamp voltage detector and 80 : lamp current detector,

90: Discharge lamp 200: Photodetection section

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